Visualisation of basic NMR

Quantum and Classical aspects

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Visualisation of basic NMR: Quantum and Classical aspects

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Handwaving and semi-classical graphics are widely used to illustrate spin dynamics such as excitation and echoes. Quantum descriptions are often accompanied by different figures such as level diagrams and cone figures. In this talk, the relation between quantum and classical mechanics is discussed with a particular focus on visualisation. It is argued that the classical and the quantum descriptions of basic NMR are more similar than they may first appear, and that „classical" illustrations can accurately depict essential aspects of quantum NMR[1]. In contrast, illustrations meant to convey quantum mechanics often do not[2]. Figures that are misleading or divert attention from crucial aspects are abundant. Simple graphical tools aimed at early NMR and MRI education are demonstrated.

Figure 1. Bloch vector visualization[3] of thermal equilibrium which is equally valid from classical and quantum perspectives.

Figure 2. The Bloch Simulator[4] is a free Flash™ application running directly in most browsers. It can be used to explore basic NMR and MRI methods such as echo formation.

1 R. P. Feynman, F. L. Vernon Jr., R. W. Hellwarth. *Geometrical representation of the Schrödinger equation for solving MASER problems*. J Appl Phys 1957;28:49–52.

2 L. G. Hanson, *Is quantum mechanics necessary for understanding magnetic resonance?* Concepts in Magnetic Resonance 2008, 32A(5), 329-340.

3 L. G. Hanson. *Introductory NMR visualisations*. Web Pages 2015. http://www.drcmr.dk/MR, http://www.drcmr.dk/bloch